The 2018 EXPORTS Pacific Experiment

Calibration of BackScatter on Lagrangian Float #92

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Summary

Optical backscatter measured on the EXPORTS Lagrangian float (#92) spanning 16 August 2018 to 01 December 2018 was calibrated based on pre-cruise calibration data.. The adjusted data is released as
EXPORTS-EXPORTSNP_oxygen_Seabird_float_20180814_R1.sb
The calibration may be updated in future releases, particularly as other EXPORTS investigators evaluate this sensor compared to other EXPORTS sensors.

1. Sensors & Mission

Float 92 was the only Lagrangian float deployed in EXPORTS 2018. It carried SBE-41-CT sensors on the top (Fig 1a) and bottom (Fig. 1b) endcaps with the entrances to the sensors separated vertically by 1.69 m. Pressure was measured with sensors attached to the inside of the top and bottom endcaps, separated vertically by ~1.15 m. A Wetlabs FLNTU backscatter and chlorophyll sensor (SN 4992, Fig. 1b) was attached to the bottom endcap with the sensing volume at the same level as the input to the bottom CTD. This report describes the 700 nm backscatter data from that sensor.

Float 92 was deployed on 14-Aug-2018 07:15Z from the *R/V Sally Ride*, sampled for 109.3 days with the last data taken on 01-Dec-2018 14:34 Z. The float was recovered

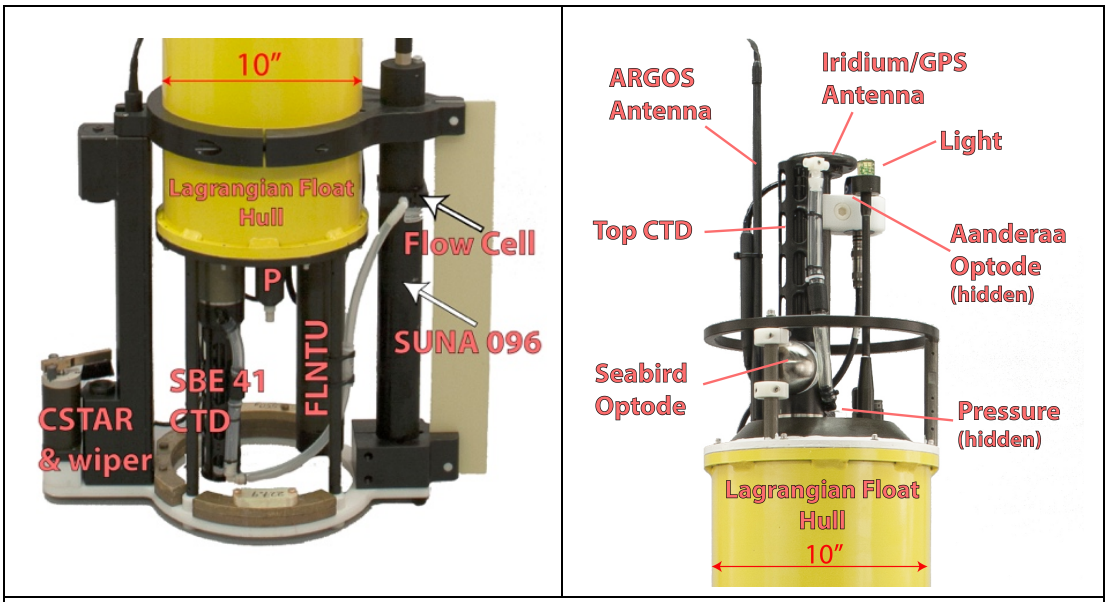

Figure 1. Sensors at a) bottom and b) top of EXPORTS float 92. A flag was attached to the top, endcap but not shown here.

shortly thereafter by *R/V Sikuliaq*. The FLNTU sampled 101198 data points, with an average separation of ~93 seconds. The float also successfully measured nitrate, oxygen, temperature, salinity and pressure. The accuracies of these sensors are described in other data reports.

The float executed a simple mission (Fig. 2) alternating between daily profiles to 200m and a Lagrangian drift at approximately 100 m. More precisely, during the drift the float targeted the 25.85 kg m^{-3} isopycnal maintaining this isopycnal between the top and bottom CTDs as it moved vertically ±10m due to internal waves and tides and mesoscale eddies (Fig. 3). Profiles occurred once per day, timed to approximating 0130Z during the cruises so as to facilitate calibration casts, and to approximately 1300Z thereafter, so as to facilitate nighttime air calibrations of the oxygen probe.

The CTD sensors on the float were sampled every 100s during the drift and 15-75s during profiles depending on other activities. Other sensors were sampled less frequently, mostly to save energy.

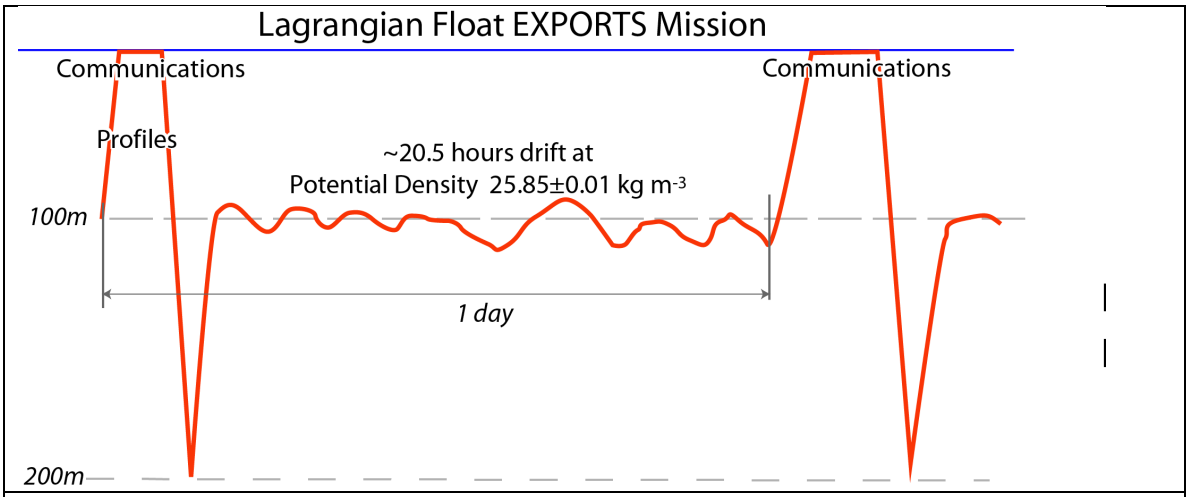

Fig. 2. Float mission. Float alternated between daily profiles from 200m to the surface and a Lagrangian drift at approximately 100m.

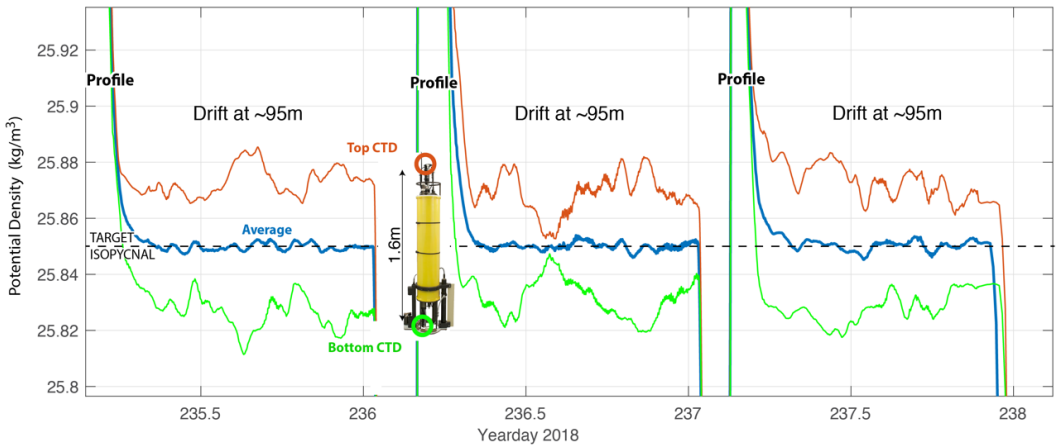

Fig. 3. Example of isopycnal drift. Float straddles target isopycnal with an accuracy of

about 0.1 m.

2. Backscatter Calibration

The FLNTU backscatter was calibrated using the formulae listed in the pre-cruise calibration certificate (Figure 4).

Sunstone Scientific LLC

NIST Traceable Calibration for Scattering Sensor

1. DESCRIPTION

The scattering sensor is calibrated to provide accurate and reproducible measurements of the volume scattering function (VSF) with an angular weighting defined by a centroid angle $\bar{\theta}$ and full-width-half-maximum (FWHM) spread $\Delta\theta$. Details of the calibration methodology can be found in Twardowski et al. (2012) and Sullivan et al. (2013).

2. PHYSICAL DATA

Sensor serial #:	FLNTUS 4992
Angular weighting centroid angle $\bar{\theta}$ (assumed):	140°
Angular weighting spread $\Delta\theta$ (assumed):	41°
Spectral weighting centroid wavelength $\bar{\lambda}$ (from manufacturer):	700nm
NIST-traceable beads (cat #: 3100A) lot #:	170408
NIST-traceable beads, certified diameter:	100 ± 3nm

Certification

$\beta(\theta_c)$ [$m^{-1}sr^{-1}$] = Scale Factor x (Raw Counts – Dark Counts)

This certifies the following specifications for this scattering sensor:

Scale Factor for 700nm:	6.51E-06 m^{-1} sr^{-1} $counts^{-1}$
Dark Counts for 700nm:	47.9 counts
Instrument Resolution for 700nm:	4.4 counts
Instrument Resolution for 700nm:	2.86E-05 m^{-1} sr^{-1}
Approximate worst case accuracy for 700nm (Considering the assumptions above*):	±2.1%
Certification date:	4/11/2018

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*Based on estimated accuracy of theoretical computation, accuracy of experimental calibration result, and assuming exact geometric consistency between sensors of the same model.

Figure 4. FLNTU backscatter calibration.

3. Data variables

Chlorophyll data from the FLNTU sensors on the bottom of the EXPORTS Lagrangian float was calibrated with data from the *R/V Sally Ride* CTD during the 2018 EXPORTS field campaign. The adjusted data is released in
EXPORTS-EXPORTSNP_oxygen_Seabird_float_20180814_R1.sb
All variables are on the same timebase. Bottom CTD intake is at the same level as the FLNTU sensing volume.

A matlab version of this file is available from the author.

Name	**Description**	**Accuracy**
Date/Time		1 sec
lat, lon	Position interpolated from GPS fix	10m at GPS fix time.
wt	Temperature ITS-90 degrees C at bottom CTD intake	±0.002 C
sal	Practical salinity EOS-80 psu at bottom S CTD intakes	±0.002 psu between sensors ±0.01 psu absolute
pressure	Pressure dbar relative to sea surface at bottom CTD intake	Relative difference is fixed. ±0.4 dbar absolute
bbcount	Raw backscatter counts	
VSF700	Volume Scattering Function 1/(m sr)	2% at calibration. Drift is unknown.